Observation of Strain-Induced Local Distortions and Orbital Ordering in Manganite Films

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Beamline(s): **X14A, X21**

Introduction: It is clear that lattice strain plays an important role in the properties of colossal magnetoresistance (CMR) materials, which creates the possibility of optimizing the properties of CMR oxides for specific applications by growing thin CMR films on substrates with different lattice spacing.[1,2] In order to understand the correlation between strain, magneto-transport properties and orbital ordering in these materials, a detailed characterization of both the long-range and short-range structure of strained films of varying thickness is required. In this abstract we present the first combined measurement of the local and long-range structure in $Nd_{0.5}Sr_{0.5}MnO_3$ films of varying thickness.

Methods and Materials: Films of $Nd_{0.5}Sr_{0.5}MnO_3$ were grown *in-situ* using the pulsed laser deposition (PLD) technique.[3] Substrates used were $LaAlO_3$ (100) (pseudocubic with a=3.791Å). Sample preparation is described in Ref. 4. The synchrotron XRD experiments were performed on the X-Ray beamline X14A at the National Synchrotron Light Source (NSLS). Linearly polarized Mn K-edge absorption spectra in fluorescence mode were measured on NSLS beamline X21A. Measurements were made for films in two orientations: one with the beam E-vector nearly perpendicular to the surface and one with the E-vector in the plane of the film.

Results. Comparisons between the local structure about Mn and the long range structure were made. We found that Mn coordination asymmetry exists in thin films and that it is related to orbital ordering. The results yield the first confirmation of models of manganite systems which suggest that biaxial strain enhances electron localization.

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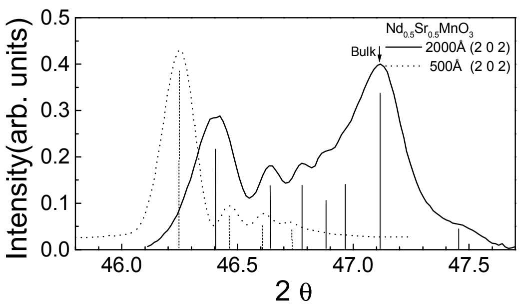

Fig. 1. X-ray diffraction θ-2θ scans of $Nd_{0.5}Sr_{0.5}MnO_3$ films with the scattering plane normal to the surface and corresponding to the direction (2 0 2). The solid line is for the 2000Å film and dotted line is for the 500Å film. The position of the bulk diffraction line is indicated by an arrow.

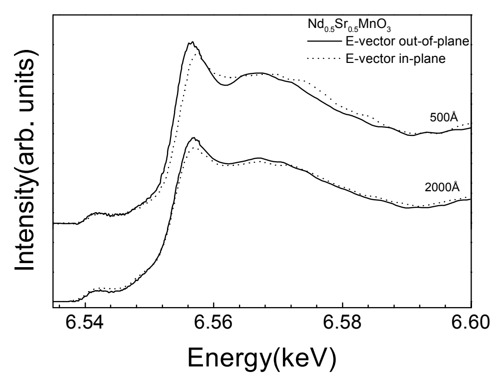

Fig. 2. Near edge x-ray absorption spectra (Mn K) of $Nd_{0.5}Sr_{0.5}MnO_3$ for 500Å and 2000Å films in fluorescent mode. The solid line is the spectrum measured when the incidence x-ray E-vector is perpendicular to film surface, while the dot line is for the measurement with the incidence x-ray E-vector parallel to film surface. Notice the asymmetry in the thin film measurement suggesting local structural distortions.